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Experimental cell for molecular beam deposition and magnetic resonance studies of matrix isolated radicals at temperatures below 1 K

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Abstract

We present the design and performance of an experimental cell constructed for matrix isolation studies of H and D atoms in solid H2/D 2 films, which are created by molecular beam deposition at temperatures below 1 K. The sample cell allows sensitive weighing of the films by a quartz microbalance (QM) and their studies by magnetic resonance techniques in a strong magnetic field of 4.6 T. We are able to regulate the deposition rate in the range from 0.01 to 10 molecular layers/s, and measure the thickness with ~0.2 monolayer resolution. The upper QM electrode serves as a mirror for a 128 GHz Fabry-Perot resonator connected to an electron spin resonance (ESR) spectrometer. H and D atoms were created by RF discharge in situ in the sample cell, and characterized by ESR and electron-nuclear double resonance. From the magnetic resonance measurements we conclude that the films are smooth and provide homogeneous trapping conditions for embedded atoms. The current sample cell design also makes it possible to calibrate the ESR signal and estimate the average and local concentrations of H and D radicals in the film.

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